Having described the preferred embodiments, the invention is now claimed to be:

1. A magnetic resonance imaging scanner including:

a generally cylindrical main magnet assembly **(10)** that defines a cylinder axis **(16)**;

a first set of shims **(60)** rigidly positioned inside the main magnet assembly **(10)** at about a first distance **($d_1$)** relative to the cylinder axis **(16)**;

a second set of shims **(62)** rigidly positioned inside the main magnet assembly **(10)** at about a second distance **($d_2$)** relative to the cylinder axis **(16)**, the second distance **($d_2$)** being different from the first distance **($d_1$)**;

a generally cylindrical radio frequency coil **(26)** arranged inside the main magnet assembly **(10)** at about a third distance **($d_3$)** relative to the cylinder axis **(16)**; and

a plurality of gradient coils **(20)** arranged inside the main magnet assembly **(10)** at about a fourth distance **($d_4$)** relative to the cylinder axis **(16)**.

2. The magnetic resonance imaging scanner as set forth in claim **1**, wherein the second distance **($d_2$)** is greater than the first distance **($d_1$)**.

3. The magnetic resonance imaging scanner as set forth in claim **1**, wherein the first distance **($d_1$)** equals the third distance **($d_3$)**.

4. The magnetic resonance imaging scanner as set forth in claim **1**, wherein the first set of shims **(60)** has a radial symmetry respective to the cylinder axis **(16)**.

5. The magnetic resonance imaging scanner as set forth in claim **4**, wherein the first set of shims **(60)** has a bilateral symmetry respective to a longitudinal symmetry plane **(72)** that is perpendicular to the cylinder axis **(16)**.

6. The magnetic resonance imaging scanner as set forth in claim **5**, wherein the second set of shims **(62)** is asymmetric about at least one of the cylinder axis **(16)** and the longitudinal plane of symmetry **(72)**.

7. The magnetic resonance imaging scanner as set forth in claim **1**, wherein the first set of shims **(60)** includes:

a generally cylindrical dielectric former **(24)**;

packets of magnetic material **(60)** disposed on the generally cylindrical dielectric former **(24)**; and

plastic encapsulation **(80, 82, 84, 86, 88, 90, 92)** encapsulating the packets of magnetic material **(60)**.

8. The magnetic resonance imaging scanner as set forth in claim **7**, wherein the plastic encapsulation **(80, 82, 84, 86, 88, 90, 92)** includes openings **(106)** through which molding fixtures are removed.

9. The magnetic resonance imaging scanner as set forth in claim **7**, wherein the plastic encapsulation **(80, 82, 84, 86, 88, 90, 92)** includes:

a separately molded trays **(80, 82, 84, 86, 88, 90, 92)** each securing one or more of the packets of magnetic material **(60)** to the generally cylindrical dielectric former **(24)**.

10. The magnetic resonance imaging scanner as set forth in claim **7**, wherein the plastic encapsulation **(80, 82, 84, 86, 88, 90, 92)** has a coefficient of thermal expansion $\alpha_{encapsulation}$ such that $\varepsilon_{ult} \geq ( \Delta\alpha \bullet \Delta T )$F.S., where $\Delta\alpha = \alpha_{encapsulation} - \alpha_{shim}$, $\Delta T = T_g - T_{min}$, $\varepsilon_{ult}$ is the ultimate strain of the encapsulation material, $\alpha_{encapsulation}$ is the coefficient of thermal expansion of the encapsulation material, $\alpha_{shim}$ is the coefficient of thermal expansion of the shim material, $T_g$ is the glass transition temperature of the encapsulation material, $T_{min}$ is a minimum use temperature, and F.S. is a factor of safety.

11. The magnetic resonance imaging scanner as set forth in claim **7**, wherein the plastic encapsulation **(80, 82, 84, 86, 88, 90, 92)** is made of a polyetherimide thermoplastic.

12. The magnetic resonance imaging scanner as set forth in claim **7**, wherein the packets of magnetic material **(60)** each include:

one or more steel plates secured together by at least one fastener **(104)**.

13. The magnetic resonance imaging scanner as set forth in claim **12**, wherein the steel plates have rounded edges to reduce stress between the steel plates and the plastic encapulation **(80, 82, 84, 86, 88, 90, 92)**.

14. The magnetic resonance imaging scanner as set forth in claim **7**, wherein the radio frequency coil **(26)** includes:

a plurality of rungs **(70)** arranged generally parallel to the cylinder axis **(16)**, wherein the packets of magnetic material **(60)** are disposed at radial positions between the rungs **(70)**.

15. The magnetic resonance imaging scanner as set forth in claim 14, wherein the first distance ($d_1$) equals the third distance ($d_3$), and the radio frequency coil rungs (70) are secured to the generally cylindrical dielectric former (24).

16. The magnetic resonance imaging scanner as set forth in claim 14, further including:

shim rings (64) arranged inside the main magnet assembly (10) at a distance larger than the first distance ($d_1$) and less than the second distance ($d_2$), the shim rings (64) being arranged symmetrically relative to a longitudinal plane of symmetry (72).

17. The magnetic resonance imaging scanner as set forth in claim 1, wherein the first, second, third, and fourth distances ($d_1$, $d_2$, $d_3$, $d_4$) are radial distances.

18. A method of making a magnetic resonance scanner, the method including:

rigidly positioning a first set of shims (60) inside a main magnet assembly (10) at about a first distance ($d_1$) relative to a cylinder axis (16) of the main magnet assembly (10);

rigidly positioning a second set of shims (62) inside the main magnet assembly (10) at about a second distance ($d_2$) relative to the cylinder axis (16), the second distance ($d_2$) being different from the first distance ($d_1$);

mounting a generally cylindrical radio frequency coil (26) inside the main magnet assembly (10) at about a third distance ($d_3$) relative to the cylinder axis (16); and

mounting a plurality of gradient coils (20) inside the main magnet assembly (10) at about a fourth distance ($d_4$) relative to the cylinder axis (16).

19. The method as set forth in claim 18, wherein the positioning of the first set of shims (60) includes:

molding a plastic material around the first shims (60); and

bonding the molded plastic material to a generally cylindrical former (24).

20. The method as set forth in claim 19, wherein the molding includes:

fastening the first shims (60) in an injection mold using at least one fastener; and

injection molding the plastic material around the first shims (60).

21. The method as set forth in claim 20, wherein the molding further includes:

after the injection molding, removing the at least one fastener.

22. The method as set forth in claim 20, wherein the molding further includes:

prior to the fastening of each first shim (60) in the injection mold, binding a selected number of metal sheets together to define the first shim (60).

23. The method as set forth in claim 19, wherein the bonding of the molded plastic material to the generally cylindrical former (24) includes:

ultrasonically bonding the molded plastic material to a separately molded tray (96); and

fastening the separately molded tray (96) to the dielectric former (24).

24. The method as set forth in claim 19, wherein the molding of a plastic material around the first set of shims (60) produces a plurality of moldings (80, 82, 84, 86, 88, 90, 92) each including at least one shim of the first set of shims (60), and the bonding of the molded plastic material to the generally cylindrical former (24) includes:

bonding the moldings (80, 82, 84, 86, 88, 90, 92) at radially spaced-apart positions around the generally cylindrical former (24).

25. The method as set forth in claim 24, further including:

securing rungs (70) of the radio frequency coil (26) to the generally cylindrical former (24) in radial gaps between the moldings (80, 82, 84, 86, 88, 90, 92).

26. The method as set forth in claim 18, wherein the molding of the plastic material around the shim (60) includes:

molding the plastic material around the shim (60); and

thermally annealing to relieve stress between the shim (60) and the plastic material.

27. A method of magnetic imaging with a magnetic resonance imaging scanner including a generally cylindrical main magnet assembly (10) that defines a cylinder axis (16), a first set of shims (60) rigidly positioned inside the main magnet assembly (10) at about a first distance ($d_1$) relative to the cylinder axis (16), a second set of shims (62) rigidly positioned inside the main magnet assembly (10) at about a second distance ($d_2$) relative to the cylinder axis (16) that is different from the first distance ($d_1$), a generally cylindrical radio frequency coil (26) arranged inside the main magnet assembly (10) at about a third distance ($d_3$) relative to the cylinder axis (16), and a plurality of gradient coils (20) arranged inside the main magnet assembly (10) at about a fourth distance ($d_4$) relative to the cylinder axis (16), the method including:

generating a substantially uniform magnetic field within a field of view by cooperation of the main magnet assembly (10) and the first and second sets of shims (60, 62);

exciting a magnetic resonance within the field of view using one of the generally cylindrical radio frequency coil **(26)** and another radio frequency coil;

spatially encoding the magnetic resonance using magnetic field gradients produced by the plurality of gradient coils **(20)**; and

detecting the excited and spatially encoded magnetic resonance using one of the generally cylindrical radio frequency coil **(26)** and another radio frequency coil.